

CHORIONIC FINE STRUCTURE OF THE EGG OF THE OAK TINGID,
CORYTHUCHA ARCUATA (SAY) (HEMIPTERA: TINGIDAE)

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Abstract.—The egg of *Corythucha arcuata* consists of two distinct regions, 1) the smooth basal portion that is surrounded by an unknown substance secreted by the female and 2) the operculum that is made up of an apical rim and cap and the most distinctive area of the egg. Reticulations cover the outer and inner surfaces of the rim, that projects outward and varies in height. The lower portion of the cap that fits into the rim is smooth and then the cap bulges outward dorsally and has a reticulated surface. The upper portion of the cap consists of over-lapping pieces of chorion. Both the rim and cap are highly porous. The thick exochorion is separated from the thin endochorion by irregularly spaced trabeculae. A vitelline membrane with a fibrous appearance is situated just beneath the chorion.

Key Words: Hemiptera, Tingidae, *Corythucha*, egg, chorion, operculum

Information on the structure of insect eggs has been used to indicate phylogenetic trends in families within Hemiptera (Southwood 1956, Cobben 1968). Hinton (1981) also presents data on the structure of hemipteran eggs including a cursory description of tingid eggs. Livingstone and Yacoob (1987) and references therein provide the only detailed biosystematic reviews of Tingidae based on morphological and biological details of the egg stage. Lace bugs belonging to the genus *Corythucha* feed on a wide variety of deciduous shrubs and trees, and populations of these species often reach pest status. The oak lace bug, *Corythucha arcuata* (Say), has been recorded from apple, maple, and roses, but feeds primarily on species of *Quercus*. Morrill (1903) and Bailey (1951) provided descriptions of the egg, nymph, and adult stages of *C. arcuata* and other *Corythucha*. There are no detailed accounts of the chorionic structure of any *Cor-*

ythucha species. In this paper we describe the chorionic fine structure and opercular region of *C. arcuata* eggs.

MATERIALS AND METHODS

Eggs of *C. arcuata* were taken from the underside of oak leaves. Fifteen eggs were fixed overnight in 4% glutaraldehyde in Nacacodylate buffer (pH 7.2) at 4°C. After rinsing in buffer, some specimens were sonicated to remove a covering placed over the eggs by the female lace bug. The sonicated and non-sonicated eggs were post-fixed in 2% OsO₄ for 4 h and then washed in distilled water. Prior to critical point drying, the specimens were dehydrated in a graded series of ethanol. The eggs were mounted on stubs with double-sided sticky tape, coated with gold-palladium, and examined with a Cambridge 360 scanning electron microscope at 15 kV. Images were recorded on Polaroid Type 55 film. Eight eggs were pro-

cessed for mounting in balsam and measurements of these eggs were taken with a light microscope with a calibrated ocular micrometer.

RESULTS

Eggs are situated on the underside of oak leaves in loose clusters. The tapered posterior end of the egg is deposited into the leaf tissue on the lower surface in a vertical position. The exposed apical end is covered by an unknown substance produced by the female (Fig. 1). The exudate has a rough appearance and is unevenly coated over the exposed outer surface of the egg (Fig. 1). The length of an egg is $583\text{ }\mu\text{m}$ ($563\text{--}604\text{ }\mu\text{m}$, $N = 8$) and $206\text{ }\mu\text{m}$ ($199\text{--}210\text{ }\mu\text{m}$, $N = 8$) wide. There is no ornamentation on the outer chorionic surface (Fig. 2). The chorion consists of an exochorion that is $2.8\text{ }\mu\text{m}$ ($2.7\text{--}3.0\text{ }\mu\text{m}$) wide and an endochorion $0.19\text{ }\mu\text{m}$ ($0.17\text{--}0.21\text{ }\mu\text{m}$) wide (Fig. 3). Irregularly spaced trabeculae separate the two portions of the chorion (Fig. 3).

The apical or opercular area of the egg is the most distinctive, consisting of a rim and a cap with a long filamentous extension (Fig. 4). The rim, which encircles the apex of the egg, varies in height from $8\text{ }\mu\text{m}$ to $27\text{ }\mu\text{m}$ and is covered by reticulations on both surfaces (Figs. 4, 5). The rim projects outward in order to accommodate the cap so that it is secured on the apex of the egg by the rim (Figs. 4, 5).

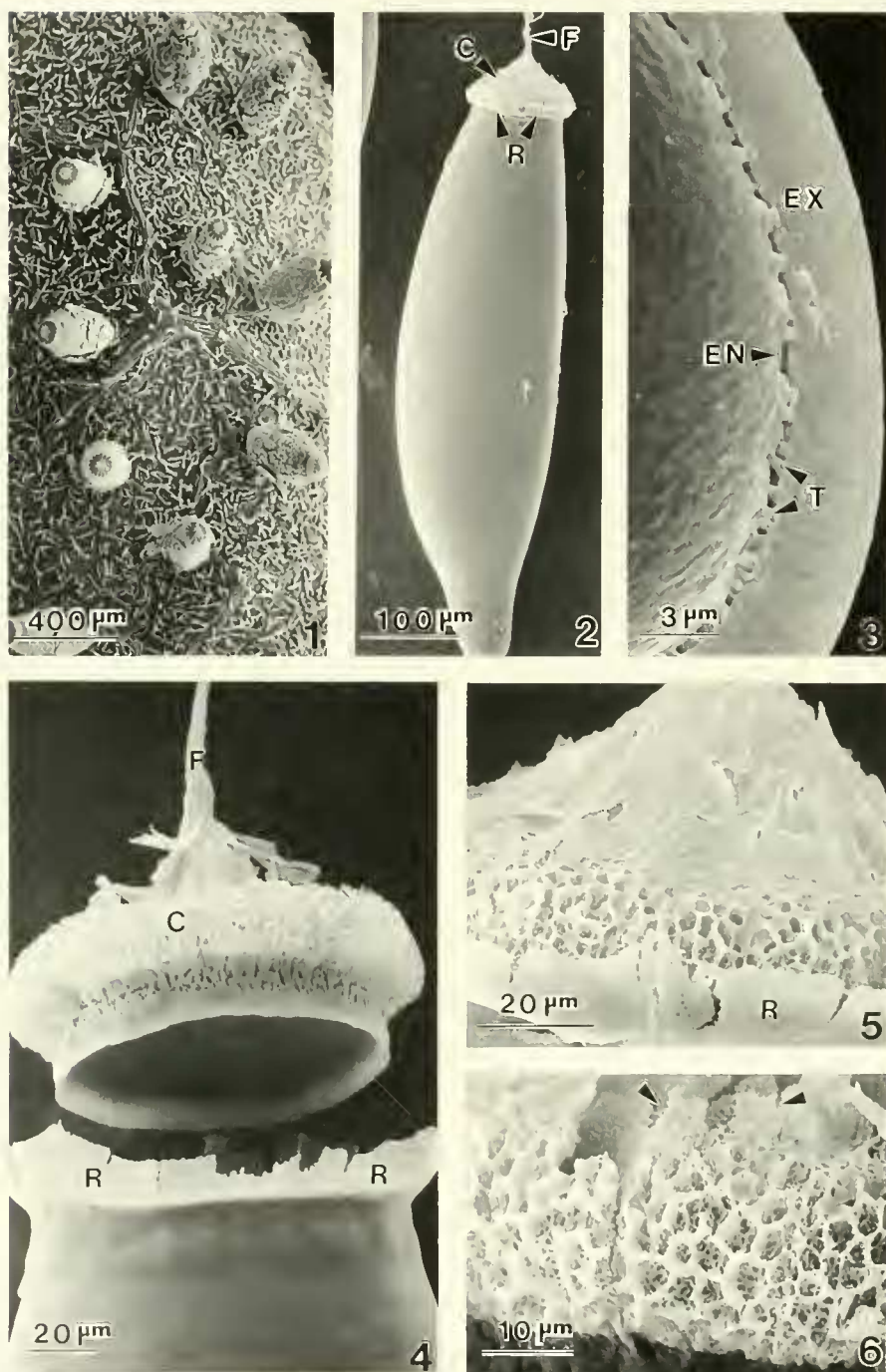
A relatively smooth band of chorion forms the lower portion of the cap (Fig. 4) and the cap bulges outward just above this smooth area (Fig. 4). The surface of the protruding portion and the lower division of the cap are deeply reticulated (Figs. 5, 6), whereas the upper division of the cap is faintly reticulated, rough-textured, and has a layered appearance (Fig. 5). Except for the smooth band at the bottom, the cap is highly porous (Figs. 5, 6) and the inner surface is smooth (Fig. 7). Immediately beneath the chorion is the vitelline membrane which is $0.03\text{ }\mu\text{m}$

thick and has a matted, fibrous appearance (Fig. 8).

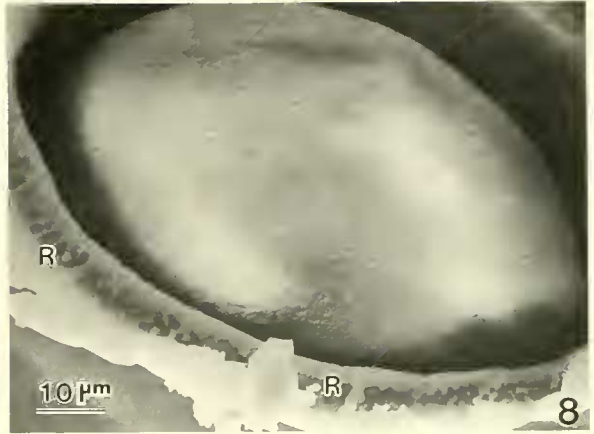
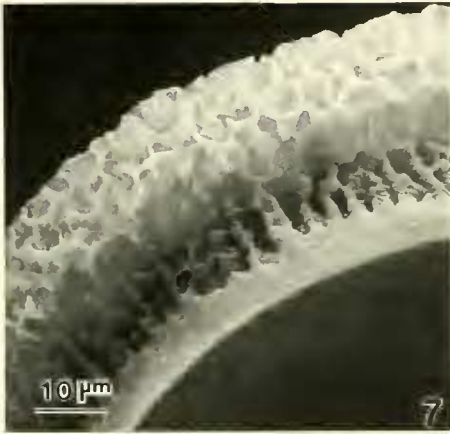
DISCUSSION

Within the family Tingidae there are several ways in which eggs are oviposited on leaf tissue, and these are put forth by Southwood (1956) and Cobben (1968). According to Cobben (1968) the deposition of eggs in batches and vertical position is considered as being (1) primitive, (2) parsimonious use of space, and (3) associated with some form of parental care. Also species within genera of Tingidae exhibit a wide variety of ovipositional behaviours such as those presented by Livingstone and Yacoob (1987) and Bailey (1951) which provide ovipositional details on the various species of *Corythucha*. Eggs of *C. arcuata* can be differentiated from other species of *Corythucha* by the shape and size of the cap and rim, whether or not the egg is coated after oviposition, the type of host plant, and where and how the egg is placed in the plant tissue. These criteria were used by Morrill (1903) to separate three species of *Corythucha*. The external coating that is placed on the eggs of *C. arcuata* occurs in other species of *Corythucha* and in other genera as well (Dickerson and Weiss 1916, Johnson 1936, Bailey 1951, Livingstone and Yacoob 1987, Neal and Douglass 1988). This coating which is produced by the female probably prevents the desiccation of the eggs which are exposed to air currents that pass over the leaf surface. Livingstone and Yacoob (1986) and Neal et al. (1991) showed that the coating on tingid eggs did not deter attacks of parasitoids or predators on the eggs.

The cap and rim are the only portions of the eggs that exhibit any type of variation from genus to genus and species within a particular genus. In earlier descriptions of *C. arcuata* eggs, such as Morrill (1903) and Bailey (1951), reference is made to the ridges that occur on the cap but ridges were not observed on the cap of the specimens ex-



Figs. 1-6. *Corythucha arcuata* egg. Fig. 1. Loose cluster of eggs on the lower leaf surface in a vertical position with outer covering. Fig. 2. Rim, cap, and filament of the operculum. Fig. 3. Section through the chorion showing the exochorion and endochorion separated by trabeculae. Fig. 4. Cap and rim separated. Fig. 5. Cap and rim joined; cap with reticulate surface. Fig. 6. Layers of the cap (arrows) and porous areas within the reticulations. C = cap, EN = endochorion, EX = exochorion, F = filament, R = rim, T = trabeculae.



Figs. 7, 8. *C. arcuata* egg. Fig 7. Smooth band at the bottom of the cap and no sculpturing on the inner surface. Fig. 8. Reticulate inner surface of the rim and the vitelline covering.

amined for this paper. There is no mention of the reticulated surface of the rim and lower portion of the cap or the layering on the upper portion of the cap. In the future, eggs of other *Corythucha* species need to be examined in order to determine the morphological differences and similarities. These data may provide important taxonomic information.

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